ATMOSPHERIC ELECTRICITY.

AURORAS.

Auroras occurred on but few dates in June, and all of the displays observed were either faint or of moderate brilliancy. The aurora of the 3d was the most extensively observed display of the month. It was reported from eastern Montana to New England coast and southward to the fortieth parallel. Although the night was generally clear and favorable for observing this display, it was only reported from widely distant stations.

Auroras were observed during the month as follows: 1st, Saint Paul, Minn.; Quakertown, Pa. 2d, Webster, Dak.; Traverse City, Mich.; Clayton, N. J.; Delavan, Wis. 3d, Bismarck, Dak.; Independence, Iowa; Bar Harbor, Orono, and Portland, Me.; Blue Hill Observatory, Cambridge, Dudley, and Provincetown, Mass.; Moorhead, Minn.; Poplar River, Mont.; Manchester, N. H.; Beverly and Clayton, N. J.; Rose and Setauket, N. Y.; Reading and State College, Pa.; Madison, Wis. 4th, Marquette, Mich.; Deuster, Wis. 5th, Marquette, Mich.; Saint Vincent, Minn. 10th, Egg Harbor City, N. J. 11th, Eastport, Me.; Wytheville, Va. 12th Wellsborough, Pa. 13th, Des Moines, Iowa. 14th, Saint Vincent, Minn.; Madison, Wis. 30th, New Haven, Conn.; Kent's Hill and Portland, Me.; Manchester, N. H.; Rose, N. Y.

THUNDER-STORMS.

Thunder-storms were most frequent in Kansas, where they were reported on every day during the month. In the Gulf states and over an area extending from the Missouri Valley eastward to the upper Ohio Valley and lower lake region they occurred on from twenty to twenty-three days. Along the middle Atlantic and New England coasts they occurred on from five to twelve days. The periods of greatest frequency were the 14–16th and 21–24th, when they were reported from twenty-seven to thirty-two states or territories. They were least numerous from 3d to 5th, being reported from eight to eleven states or territories on these dates.

Table showing the number of stations in the several states and territories reporting thunder-storms for each day during June, 1888.

State or Territory.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.
Ala.	..	..	..	..	..	..	..	..	..	..	1	2	1	3	1	2	2	..	3	2	4	1	1	2	2	2	1	1	3	..	2
Ariz.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	3	..
Ark.	2	1	..	..	..	3	..	3	2	2	..	4	..	1	2	2	3	2	1	1	4	3	2	2	2	1	1	..	..	..	..
Cal.	1	2	..	..	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..
Colo.	3	2	..	..	..	..	..	..	2	..	..	1	..	2	3	2	4	1	1	1	1	1	..	1	1	1	1	..	..	..	..
Conn.	..	..	..	..	..	2	..	..	..	..	..	..	1	3	..	1	..	..	..	..	..	..	1	1	1	2	..	..	1	3	..
Dak.	..	..	5	10	..	2	8	5	2	..	5	7	6	6	5	4	1	..	4	5	..	..	1	2	2	2	1	6	7	..	..
D. C.	..	..	..	..	..	..	..	..	1	..	..	..	1	..	1	..	..	..	..	..	..	1	1	..	..	..	..	..	..	..	..
Fla.	5	3	4	3	..	..	..	..	2	2	2	5	5	2	4	3	5	3	3	3	3	3	4	..	4	3	4	3	5	..
Ga.	1	2	..	..	..	..	..	..	2	..	3	2	4	4	2	2	1	3	3	..	1	2	1	1	1	4	1	2	3	1	..
Ill.	2	1	..	..	4	8	15	16	12	..	..	..	4	6	16	8	7	16	20	16	25	9	3	6	4	15	12	..	..	..	..
Ind.	..	..	..	..	..	3	..	3	1	2	..	..	3	..	3	1	1	2	..	..	5	5	2	..	..	2	1	..	..	..	..
Ind. T.	..	..	3	..	..	1	1	4	2	1	..	..	..	..	..	..	1	..	2	1	3	4	5	1	..	3	..	..	..	..	..
Iowa.	..	..	..	6	19	2	3	6	5	2	4	11	14	16	1	..	12	10	16	22	11	1	2	2	..	5	..	..	..	1	..
Kans.	5	2	3	2	1	1	2	11	3	1	3	8	3	7	2	1	5	3	10	8	7	5	3	7	4	7	1	1	1	1	..
Ky.	..	..	..	..	1	2	..	1	..	2	..	..	..	..	2	1	..	..	..	..	..	1	1	..	1	..	..	..	..	..	..
La.	..	3	..	..	..	4	..	1	1	2	2	3	4	3	1	1	1	3	5	..	1	1	1	4	4	..	3	..	4	..	..
Me.	..	..	..	..	..	6	2	..	..	..	..	..	..	..	3	..	..	..	..	..	..	..	5	..	1	..	..	..	1	2	..
Md.	..	..	..	..	..	..	..	..	2	..	..	..	1	..	3	..	1	1	..	2	..	1	..	..	..	1	..	..	..	..	..
Mass.	..	..	..	..	10	8	..	..	..	1	..	..	2	12	..	..	1	..	..	2	2	11	5	..	1	..	..	..	..	13	..
Mich.	5	..	..	1	5	..	..	2	14	5	..	2	27	20	5	2	1	6	6	7	17	5	4	2	..	..	..	1	2	..	..
Minn.	..	..	..	5	4	..	5	8	1	..	..	11	7	..	..	2	..	5	5	3	..	..	..	1	..	1	..	..	3	5	..
Miss.	1	1	..	..	..	..	..	..	1	..	..	..	1	1	1	..	2	1	..	..	..	2	..	2	1	..	1	1	..	1	..
Mo.	1	..	..	..	..	2	2	4	1	..	..	2	..	..	2	..	2	3	3	1	2	4	2	1	2	..	4	..	..	..	..
Mont.	..	1	2	1	..	..	2	1	..	..	4	..	2	..	..	2	1	1	2	2	..	..	..	..	1	1	..	2	..	1	3
Nebr.	1	2	..	2	5	6	1	2	..	..	4	7	6	4	1	..	3	4	8	1	..	..	1	..	2	9	1	2	3	1	..
Nev.	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
N. H.	..	..	..	..	..	5	3	..	..	..	..	..	..	..	4	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	5	..
N. J.	..	..	..	..	..	2	..	..	..	1	..	..	..	4	4	7	..	1	..	..	3	..	8	3	..	4	1	1	..	3	..
N. Mex.	..	..	..	..	..	3	..	1	..	1	2	..	..	2	1	2	2	4	..	..	..	..	..	2	..	..	..	..	2	4	..
N. Y.	..	5	..	..	..	6	..	..	..	14	2	..	3	11	18	1	..	2	..	1	5	7	13	16	1	5	..	..	..	9	..
N. C.	3	3	1	..	..	..	3	2	2	..	2	1	..	1	1	..	2	..	2	1	1	1	..	5	..	..	2	2	..	..	..
Ohio.	..	..	1	..	2	5	..	1	11	12	..	1	12	12	10	..	..	..	..	3	10	16	12	3	1	3	1	..	..	..	..
Oregon.	..	4	1	..	..	1	1	..	4	1	..	..	1	1	..	..	..	..	..	2	..	..	1	..	..	..	..	..	3	1	..
Pa.	..	8	..	..	..	8	1	..	6	22	1	..	..	21	23	13	..	..	6	..	1	30	15	32	22	..	2	1	3	1	3
R. I.	..	..	..	..	..	..	1	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
S. C.	1	..	1	..	..	1	2	2	..	3	1	3	1	1	2	2	..	2	..	1	2	1	1	2	3	3	5	2	..	..	..
Tenn.	3	..	..	..	6	3	6	4	11	1	..	3	7	12	10	5	3	13	8	3	7	8	4	..	3	3	6	..	..	..	..
Tex.	..	3	..	..	2	3	7	2	..	2	5	2	2	3	1	5	5	1	5	1	1	8	9	9	4	1	2	2	1	1	..
Utah	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..
Vt.	..	..	..	..	..	7	..	..	..	4	..	..	1	5	..	..	..	..	..	4	2	3	5	3	..	1	..	1	..	3	..
Va.	..	2	..	..	..	1	..	..	1	7	1	..	..	2	2	9	..	1	..	..	6	2	4	4	1	3	4	5	..	..	..
Wash.	1	..	..	..	..	2	1	..	6	2	1	..	..	3	..	1	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..
W. Va.	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1	..	..	..	..	1	2	1	1	..	..	..	..	..	..	..
Wis.	..	..	..	..	3	..	..	1	5	1	..	..	10	11	..	..	..	5	7	7	5	..	1	..	..	..	..	..	..	..	..
Wyo.	2	1	2	1	..	2	2	..	..	1	..	1	..	..	..	1	2	1	4	..	..	1	1	..	..	4	1	..	1	..	..
Total No. states rep'g	18	18	10	8	11	29	21	21	22	25	20	18	21	32	31	29	22	28	24	22	28	27	33	32	18	26	23	19	18	23	..

MISCELLANEOUS PHENOMENA.

DROUGHT.

Amherst C. H., Amherst Co., Va., 18th: no rain has fallen here during the past sixteen days and drought is beginning to affect the crops.

Catawissa, Columbia Co., Pa.: the drought which caused some injury to crops in this vicinity prior to the 21st was broken by the rain on that date.

Camden, Kershaw Co., S. C.: heavy rains fell on the 1st and 13th, but at the close of the month the weather was very dry and crops were suffering.

Vevay, Switzerland Co., Ind.: quite a severe drought prevailed here prior to the 27th, on which date there was an abundant rain.

Columbus, Ohio: the general rain which fell on the 28th was of great benefit in this section where the drought was becoming serious to all growing crops and pasturage. The hay is reported to be very light in this vicinity, due to the deficiency in rainfall.

Fort Apache, Ariz.: the light rain on the 29th was the first that had fallen here since May 4th. Vegetation has suffered seriously from the protracted drought.

Livingston, Sumter Co., Ala.: the weather was extremely dry during the first three weeks of the month, and much of the early corn was permanently injured.

HALOS.

The dates on which solar halos were observed over the greatest extent of territory during June were the 5th, 9th, 13th, and 19th; they were least numerous from the 1st to 3d, 10th, and 30th; they were observed on ten days in New York, Ohio, and Washington Territory, California reporting the maximum, eleven days.

But few lunar halos were observed from the 1st to 13th and from the 24th to 30th, there being eight days during these periods on which none were observed; lunar halos were quite numerous from the 16th to 20th; they were seen on from six to eight days in Alabama, Missouri, Pennsylvania, Texas, and Virginia. None were reported from Connecticut, Delaware, District of Columbia, Indian Territory, Maine, Maryland, New Hampshire, New Mexico, Rhode Island, Utah, Vermont, and Wyoming.

The phases of the moon, Washington mean time, during June, as given in "The American Ephemeris and Nautical Almanac," are as follows: new moon, 8th, 23h. 25.8m.; first quarter, 16th, 13h. 41.5m.; 23d, 3h. 59.3m.; last quarter, 30th, 10h. 44.4m.; apogee, 5th, 16.2h.; perigee, 21st, 7.1h.

METEORS.

Prof. J. A. Mitchell, Mount Saint Mary's College, Emmitsburg, Md., furnishes the following:

At 10.45 p. m. Monday evening, June 10th, a meteor of extraordinary brilliancy passed over that portion of the heavens occupied by the constellations Aquila and Ophiuchus. It was first seen to emerge near the star Alpha Aquila, and then finally disappeared behind a cloud near the star Theta Ophiuchi. The size of the disk was about one-fourth the apparent diameter of full moon. At first it presented an elongated appearance, one end of which developed into a tail of about five apparent diameters of full moon. The color of the nucleus was at first of a pale blue, changing very suddenly to a reddish tinge. The duration of its appearance was about five seconds, and its brilliancy was such that the country appeared as if suddenly illuminated with the electric light. I may add that I have not observed a meteor of such superior beauty and brilliancy since the summer of 1885.

The Signal Service observer at Sebastian, Fla., reports:

At 12.30 a. m. of the 23d instant, while returning from a repair trip thirty miles south of station, a beautiful meteor of more than ordinary brilliancy was seen. It appeared to be about one-fourth the size of the moon. Appearing in the western horizon, about forty-five degrees from the zenith, it moved in a northerly direction first parallel with the earth then describing part of an elliptical curve, was dissipated apparently within twenty-five degrees of the horizon on a line running north and south, traversing about ninety degrees of space. The meteor was sufficiently large to cast a shadow upon the cabin of the boat; following it was a train of dazzling light, apparently some twenty feet in length, which lasted six or eight seconds. The color at first was a bright red changing to orange. The smoky cloud which was subsequently formed finally disappeared in a perpendicular direction, or at right angles to the primitive line of the meteor. The night was cloudless, with a very light southerly wind. This meteor was so luminous that it attracted the attention of persons whose backs were turned to it. It was by far the most brilliant of the numerous meteors observed by me on previous occasions.

Meteors were also observed as follows: 1st, 3d and 6th, Duke, Fla. 8th, Auburn, Ala.; Kalamazoo, Mich.; Utica, N. Y., and Clebourne, Tex. 9th, Provincetown, Mass., and Stateburg, S. C. 10th, Washington, D. C.; Baltimore, Md., and McMinnville, Oregon. 12th, Lava, N. Mex. 13th, Beverly and Clayton, N. J. 15th, Kalamazoo, Mich. 17th, Pittsburg, Pa. 19th, Egg Harbor City, N. J.; Stateburg, S. C. 20th, Utica, N. Y. 22d, Fort McDermit, Nev.; Albany, Oregon. 23d, Cairo, Ill. 25th, Cairo, Ill.; Elk Falls, Kans. 26th, Cleburne, Tex. 27th, Humphrey, N. Y. 29th, Beloxi, Miss.

MIRAGE.

Moorhead, Minn.: a very distinct and well-defined mirage, showing villages, streams, railways, lakes, and distant hills, was observed in nearly all directions, especially in the southeast, during almost the entire day on the 1st. A similar phenomena was also observed in the southeast at 3 p. m. on the 27th. Mirage was also observed at Webster, Dak., on the 1st, 2d, 6th, 10th to 14th, 17th, 25th, 27th, 28th, 30th, and at Traverse City, Mich., on the 2d.

SAND STORMS.

Fresno, Cal., 2d, 3d, 6th, 11th, 16th, 19th, 24th, 26th, 27th. Yuma, Ariz., 3d, 17th. Fort Sully, Dak., 4th. Willcox, Ariz., 6th, 7th, 18th, 28th. Whipple Barracks, Ariz., 17th to 19th. Fort Bowie, Ariz., 18th.

VERIFICATIONS.

INDICATIONS FOR 33 HOURS IN ADVANCE.

The percentages of verifications of the tri-daily indications for June, 1888, as determined from comparison of succeeding telegraphic reports, are given in the table below.

The predictions for all districts east of the Rocky Mountains for June, 1888, were made by Professor Cleveland Abbe, and those for the Pacific coast districts were made at San Francisco, Cal., by 2d Lieutenant J. E. Maxfield, Signal Corps; the verifications for all districts were determined by Junior Professor C. F. Marvin.

Percentages of indications verified, June, 1888.

States.		States.	
Maine	67.70	Kentucky	79.03
New Hampshire	63.50	Ohio	79.13
Vermont	63.93	West Virginia	80.87
Massachusetts	67.07	Indiana	76.27
Rhode Island	68.43	Illinois	78.57
Connecticut	72.00	Lower Michigan	74.07
Eastern New York	77.33	Upper Michigan	68.40
Western New York	78.40	Wisconsin	72.73
Eastern Pennsylvania	77.17	Minnesota	75.90
Western Pennsylvania	77.40	Iowa	74.90
New Jersey	79.77	Kansas	73.07
Delaware	78.57	Nebraska	72.03
Maryland	74.37	Missouri	79.77
District of Columbia	72.93	Colorado	67.43
Virginia	74.37	Eastern Dakota	68.20
North Carolina	76.87	Southern California*	86.16
South Carolina	73.43	Northern California*	83.27
Georgia	73.07	Oregon*	81.97
Eastern Florida	77.73	Washington Territory*	82.33
Western Florida	77.90	*By elements:*	
Alabama	78.67	Weather	81.25
Mississippi	80.87	Wind	76.90
Louisiana	82.47	Temperature	66.51
Texas	81.27		
Arkansas	80.07	General average	74.92
Tennessee	76.23		

*In determining the general average percentage for the different elements, the Pacific coast states have not been included.

CAUTIONARY SIGNALS.

Of the total number of cautionary and storm signals ordered during June, 1888, it was practicable to determine the justification or failure of eleven; justified, four, or 36.36 per cent. Of the above, ten were ordered for cautionary signals; number justified, four, or 40.00 per cent. One storm signal was ordered, and was not justified. Total number of direction signals ordered, eleven; justified, ten, or 90.90 per cent. Number of signals ordered for easterly winds, nine; all, or 100 per cent., of which were justified. Number of signals ordered for westerly winds, two; justified, one, or 50.00 per cent. Number of storms without signals, fifteen. Number of signals ordered late, *i. e.*, after the justifying velocity had begun, three, or 27.27 per cent.

LOCAL VERIFICATIONS.

The following extracts from the published reports of the state weather services for June, 1888, show the percentages of verification of weather and temperature signals for the various states:

Michigan.—Weather signals are now displayed in one hundred and forty towns in the state, and upon the baggage-cars of twenty-six trains of eight of the principal railroads of the state.

The indications and cold-wave warnings are issued by the Chief Signal Officer and distributed to the different stations through the central office. The indications are issued at 1 a. m., daily, from the Chief Signal Office, Washington, and are for the twenty-four hours from 7 a. m. to 7 a. m.

The percentage of verification of these indications for June is as follows (the verification is taken from reports of displaymen furnished this office monthly): temperature, 82.2 per cent; weather, 81.5 per cent.; temperature and weather, 81.9 per cent.

Weather signals are displayed on the baggage cars of the following railroads: C. & G. T. R'y; D., G. H., & M. R'y; D. D. G. T. R'y; M. C., main line and branches; C. & W. M. R'y; G. R. & I. R'y; P. H. & N. W. R'y; and the P. O. & P. A. R'y.

The signals are carried on the first trains leaving terminal points in the morning, and the indications of the weather are for twenty-four hours from 7 a. m. of the day of display.

The signals on the trains are read from front to rear.

When two weather signals are displayed, as the white square followed by blue square, it indicates "fair weather followed by rain or snow."

The black triangle in front of the blue or white square indicates higher temperature. If last in the display it indicates lower temperature. If not displayed, stationary temperature is indicated.

Minnesota.—The verification of weather signals were: 77 per cent. for weather, and 86 per cent. for temperature.

Nebraska.—The percentages of correct weather predictions for the state were: temperature, 93.2; weather, 80.8; mean, 87.0.

Ohio.—The percentage of verification of weather signals received from the Signal Office in Washington, and distributed to forty display stations, was 80 for weather, and 84 for temperature. No cold wave signals were ordered during the month.

South Carolina.—The percentages of verifications of the weather and temperature predictions for the state were: weather, 68.0; temperature, 88.2.

Tennessee.—The percentages of verifications of weather and temperature predictions sent daily from the Signal Office at Washington to the various stations in the state were for the state: weather, 91.3 per cent.; temperature, 90.4 per cent.

STATE WEATHER SERVICES.

The following extracts are republished from reports for June, 1888, of the directors of the various state weather services: